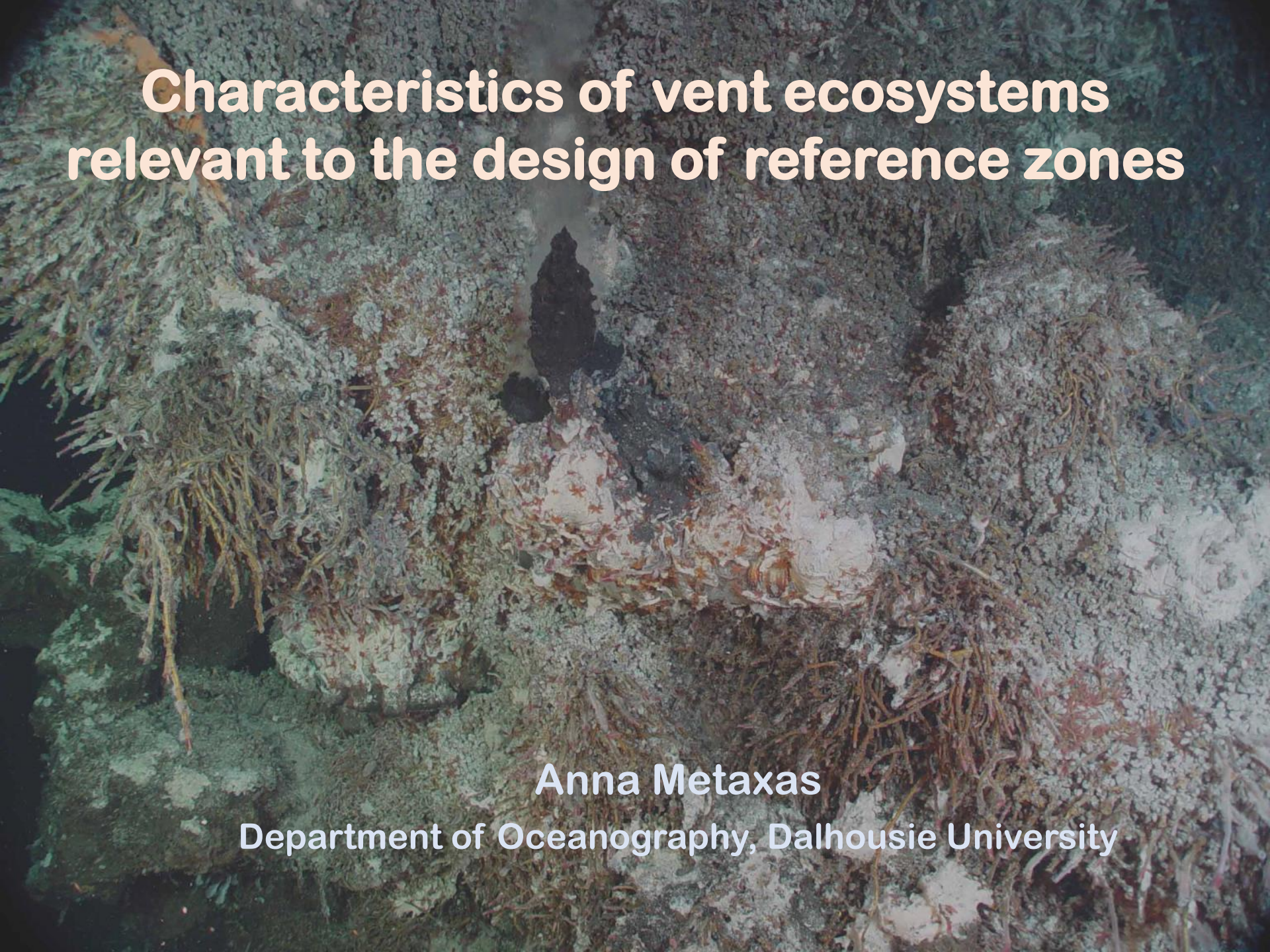
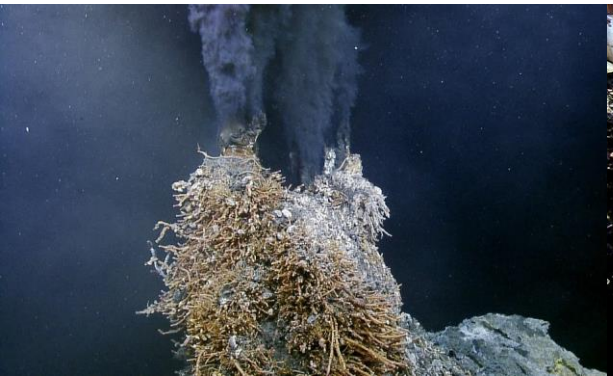
Characteristics of vent ecosystems relevant to the design of reference zones



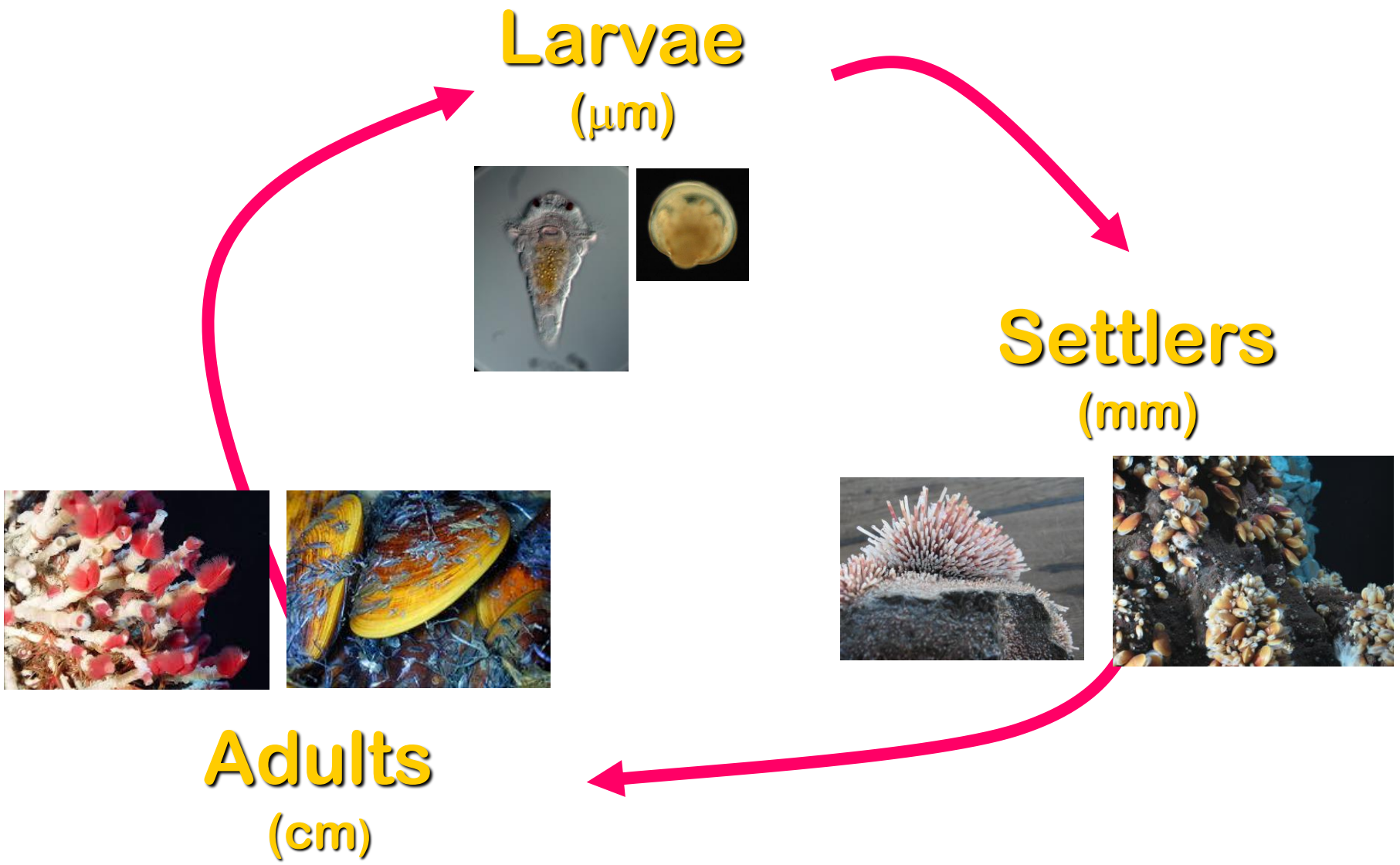
Anna Metaxas
Department of Oceanography, Dalhousie University

Vent ecosystems at a glance

- Ecosystems fuelled by microbes which use the fluid as energy
- Most species are only found at hydrothermal vents
- Their habitat is patchy and not very extensive (10s -100s m^2)

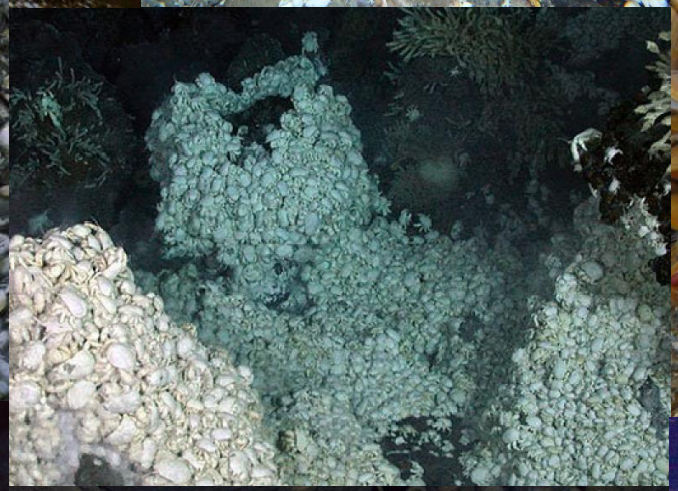


Species with complex life cycles









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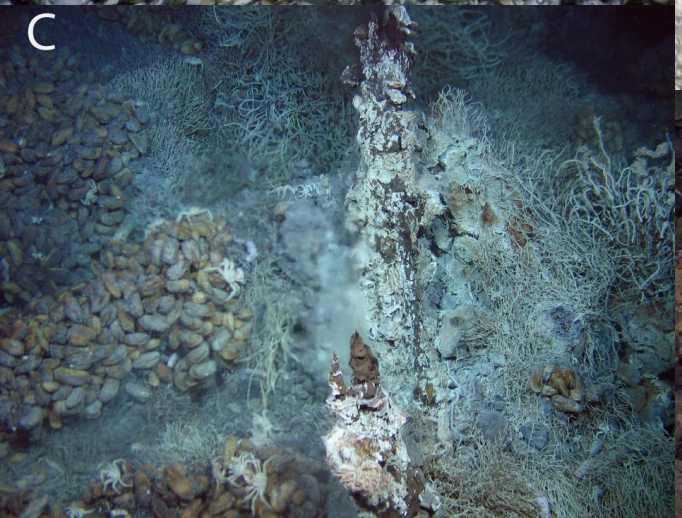
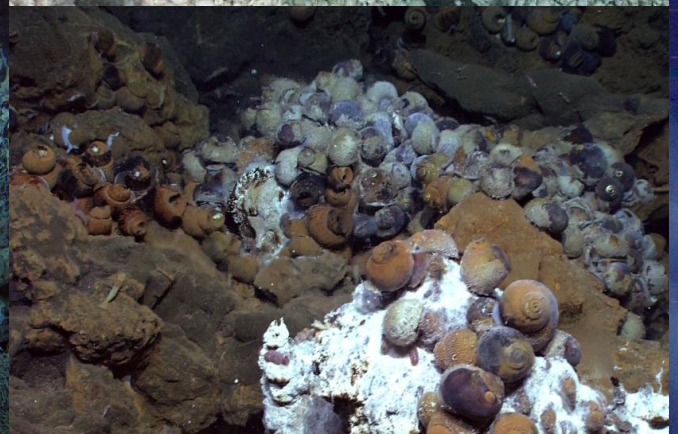
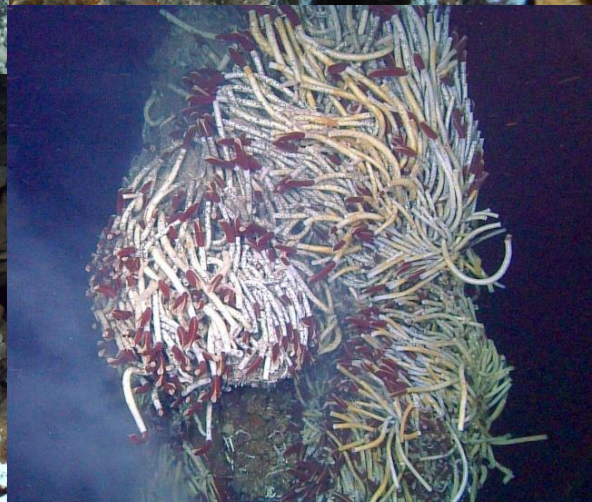
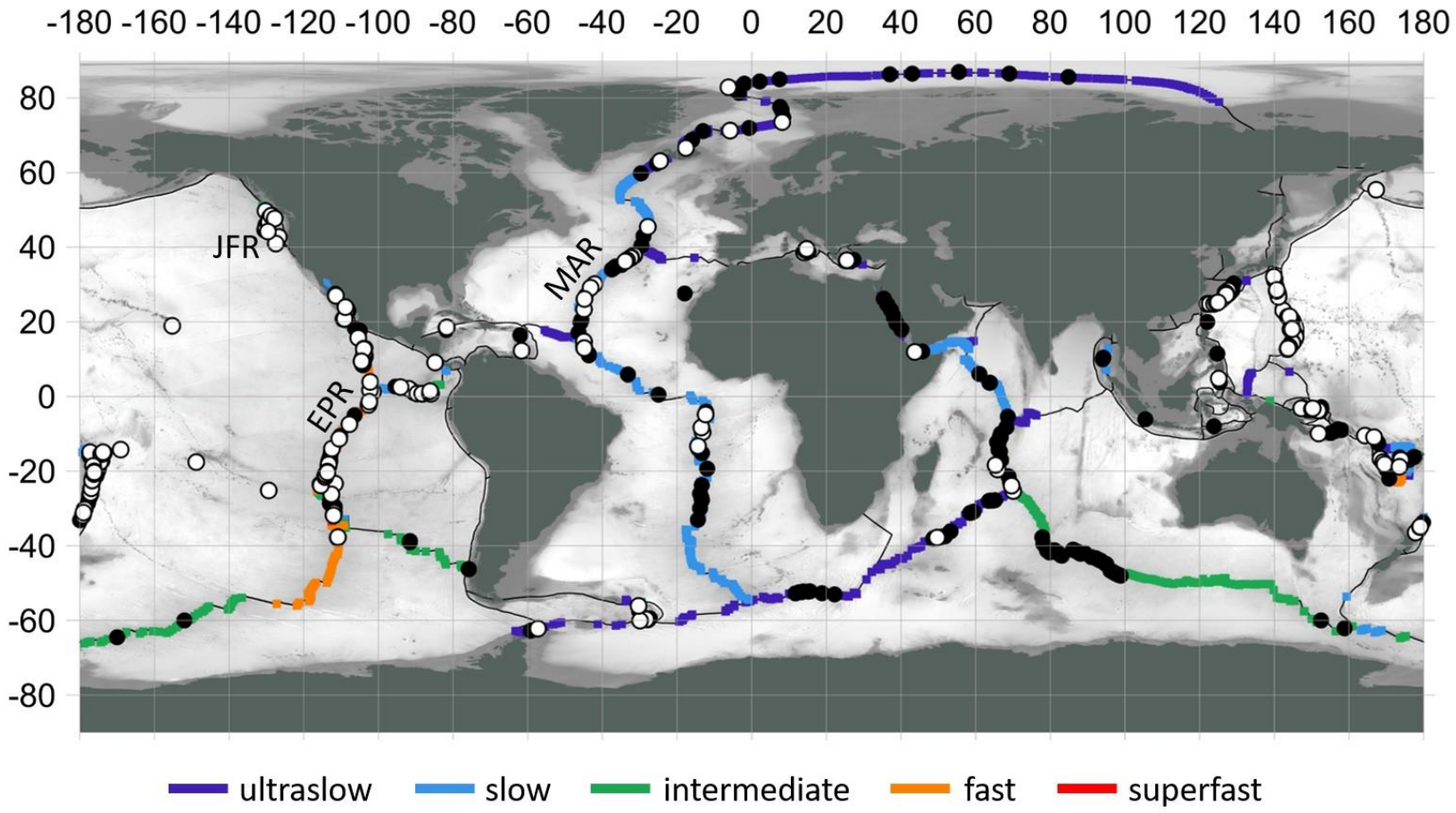




How much do the ecosystems vary *naturally* over time?

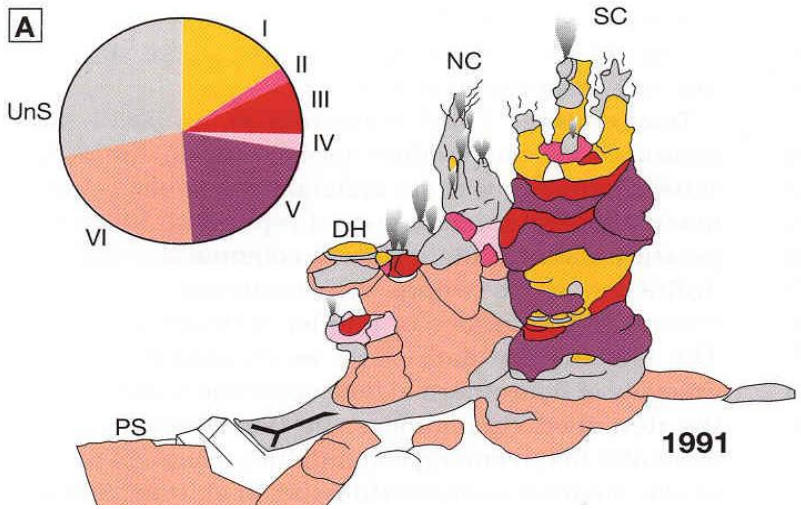
It depends

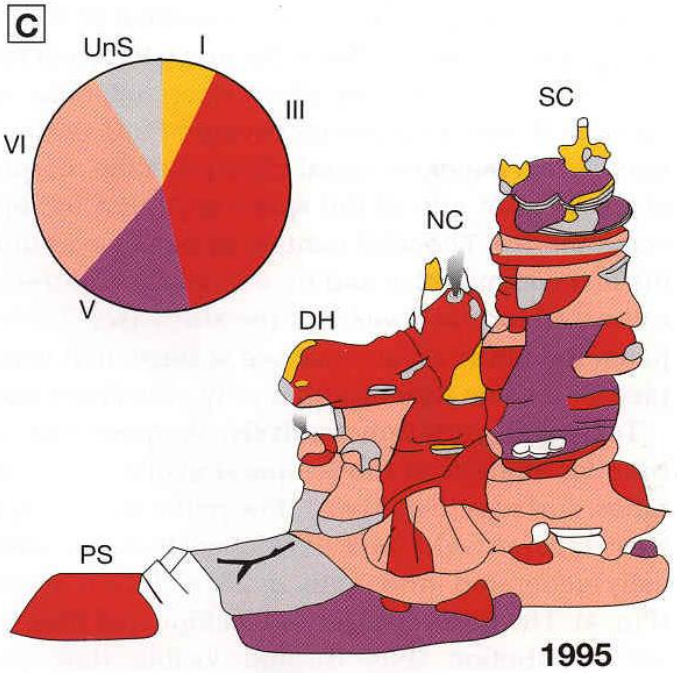
Spreading rate (as it relates to disturbance rate)

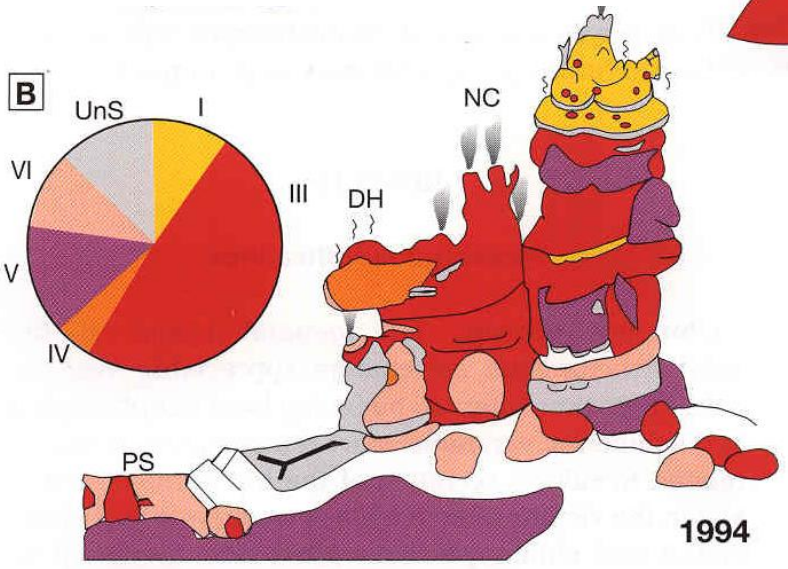


Mullineaux, Metaxas et al. in review

Juan de Fuca – Endeavour

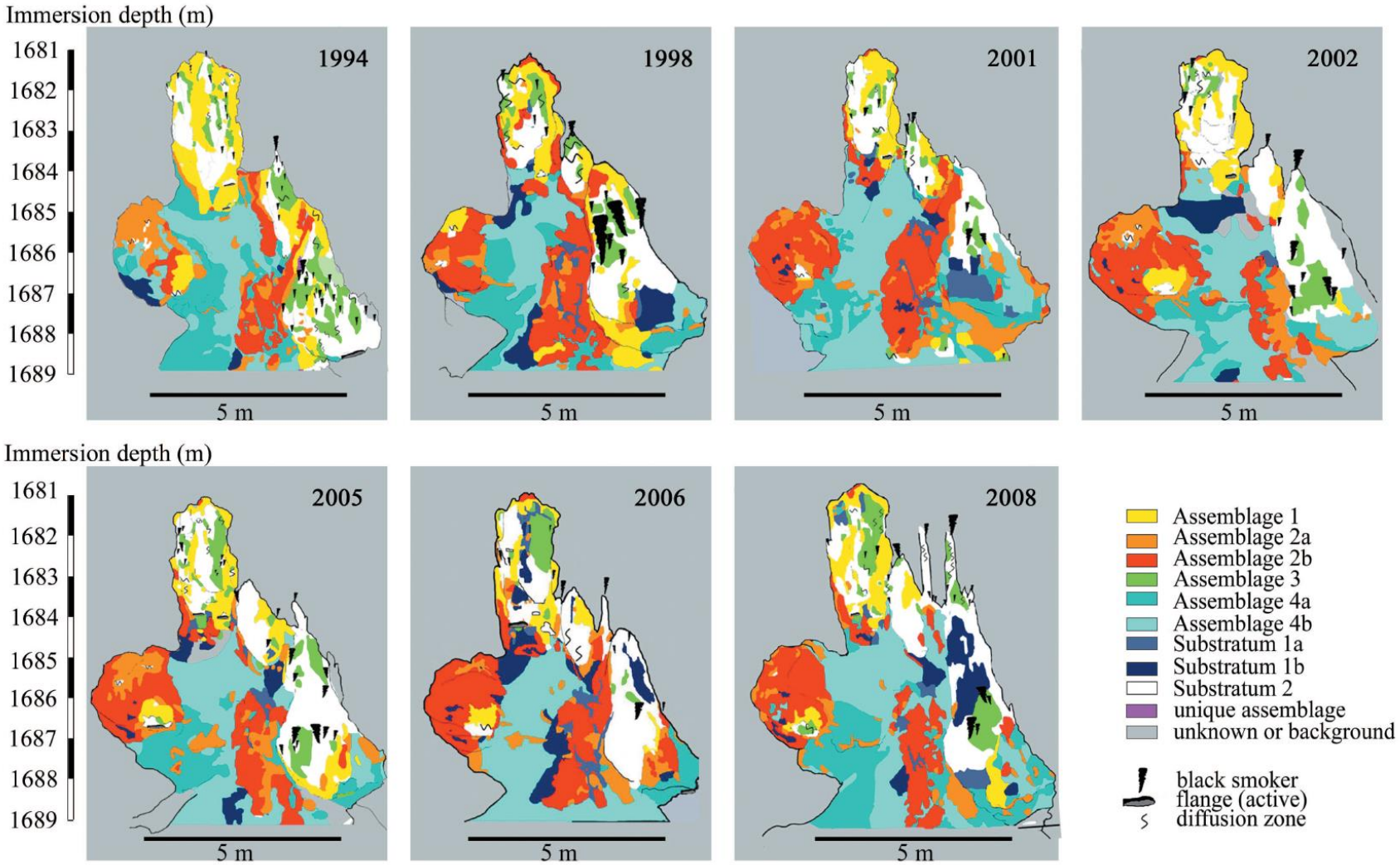






Sarrazin et al. 1997

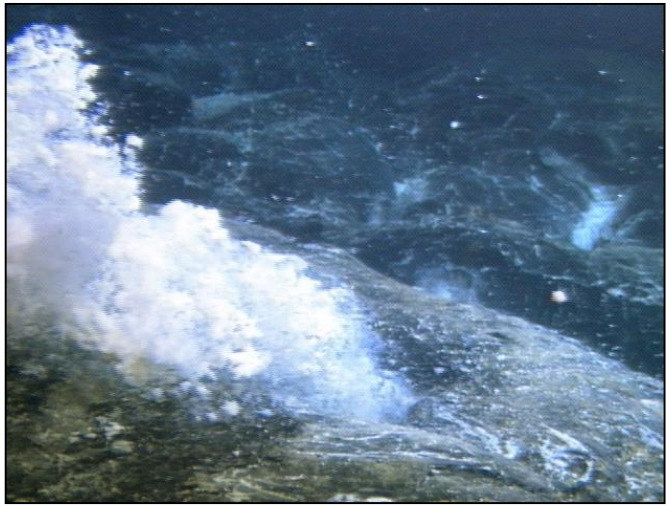
Mid Atlantic Ridge - Lucky Strike

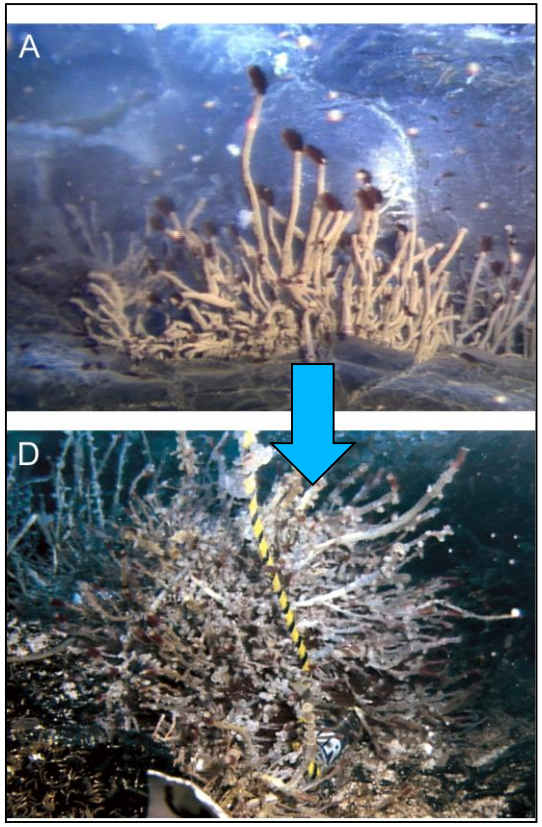


Cuvelier et al. 2011

Juan de Fuca – Axial Volcano

Four studies on recovery – two on Juan de Fuca





In 3 years, over 60% of the volcano species pool had returned!(BUT = 50% of Endeavour pool)

Tunnicliffe et al. 1997, Marcus et al. 2009

Larval dispersal - colonizing vents

How far larvae travel depends on

- How long they live

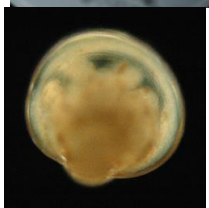
  50% of deep-sea larvae: 35 days
  75% of deep-sea larvae: ~ 70 days

- How fast the currents move

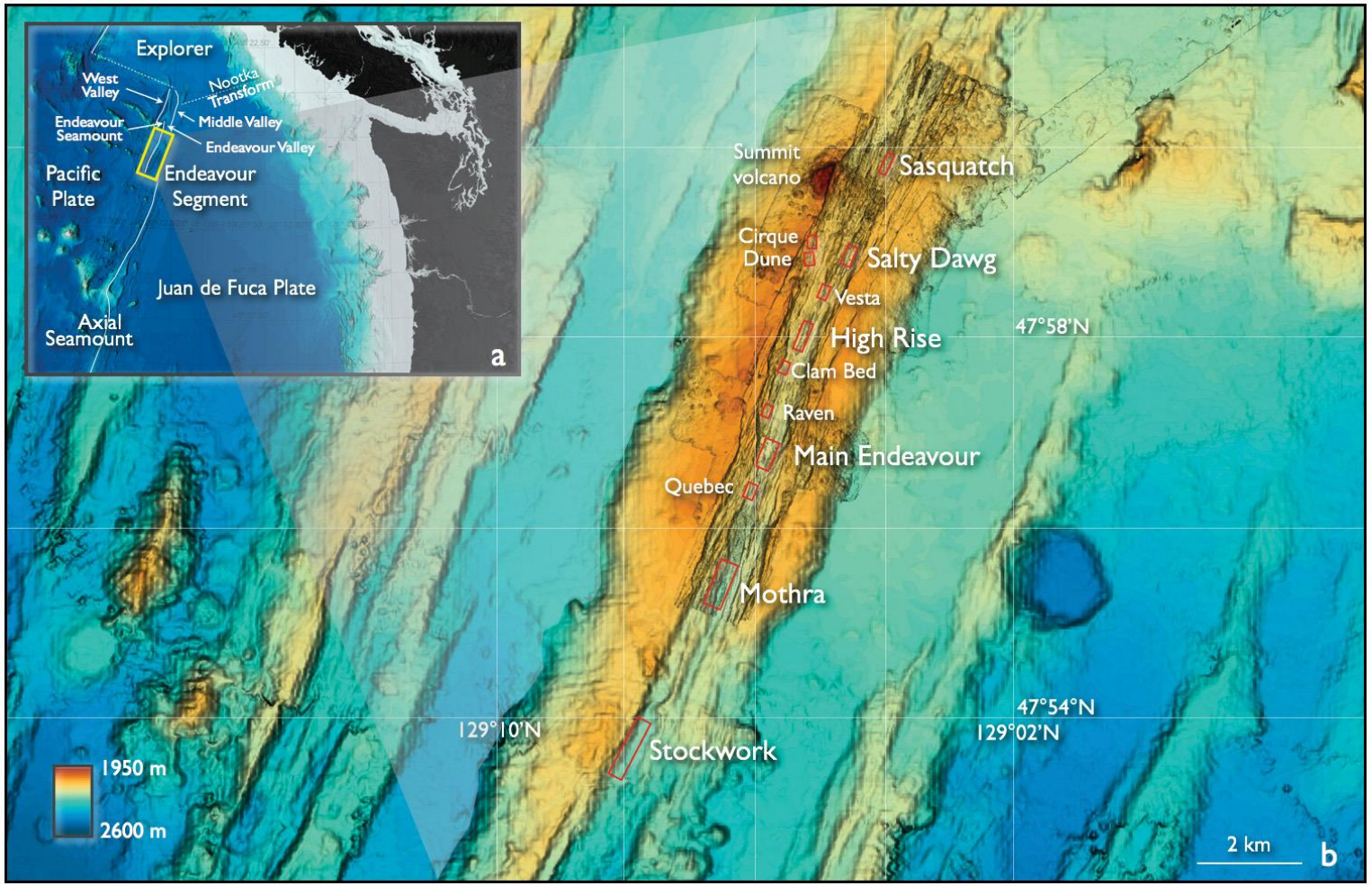
  1 – 10 km per day

- Geological formations on the seafloor

  They steer the currents



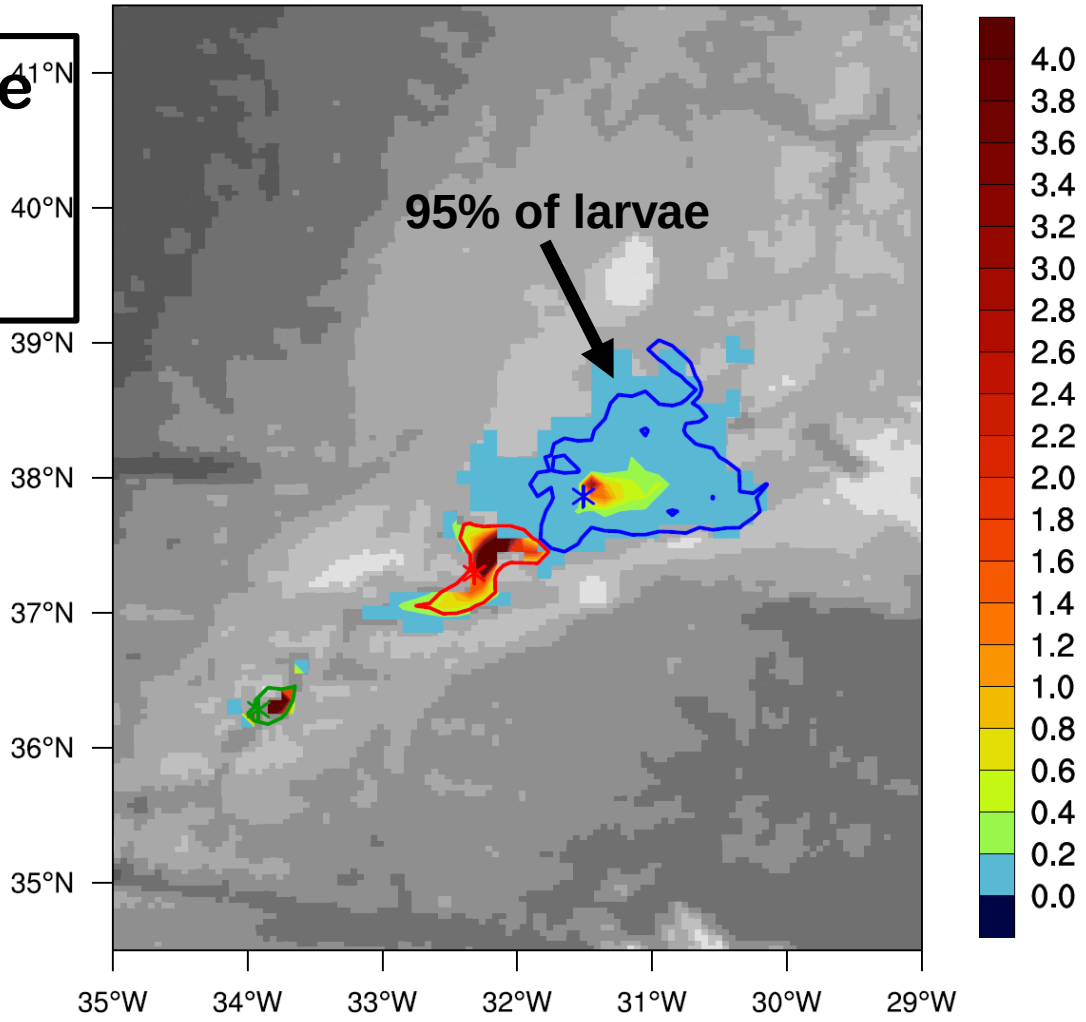
Population connectivity



Dispersal probabilities using a biophysical model *Bathymodiolus* spp. (travelling for 6 months)

Max distance to ensure connections

100 km



* Rainbow
* Lucky Strike
* Menez Gwen

Breusing et al. (2016)

Larval settlement – everywhere is not the same

Kelly et al. (2007)

Reference zones – Design considerations

How large?

- Viable population that can self recruit
- Different potentially linked habitats within one zone (e.g. focused and diffuse flows)

Baseline data: distribution of habitat types, settlement preferences, ocean circulation, larval availability; site specific

Reference zones – Design considerations

How many?

- **Adequate replication of all represented habitat types**
- **Multiple populations (including source populations)**

Baseline data: **variability in abundance, diversity, rates of settlement; used to calculate the number needed using standard statistical approaches; ocean circulation; site specific**

Reference zones – Design considerations

How far apart?

Ensure larval dispersal between units

Based on literature: **≤ 100 km**

How long? **< 10 to > 100 years**

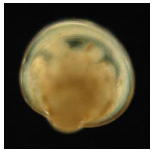
Baseline data: **rate of natural ecosystem change; site specific**

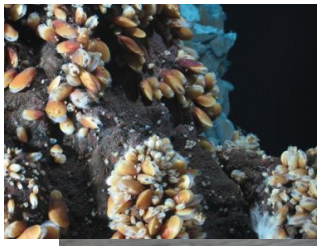
Network of well-connected units (via dispersal)

Reference Zones: Design considerations

Larvae

How large?
How many?
How connected?





Impact

Settlers

How large?
How many?

Adults

How large?
How many?
For how long?


Thank you!